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(The Organ of the Mysore Farmers' Forum)

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Order No. G.A.D. (S.I.) 23-SSR-57 ***Bangalore, Dated, the 4th July 1957***

The Heads of Departments and their Subordinates or permitted to extend to the Mysore State Young Farmers' Association all possible help and co-operation not involving Government in any financial commitment subject to the condition that their official duties do not thereby suffer.

(Sd.) C. R. SESHADRI,
For Chief Secretary to Government
GAD (Services).

To

The Heads of Departments.
The Divisional Commissioners.
The Branches of the Secretariat.
The Secretaries to Government.
The Deputy Commissioners/
Collectors of Districts.

The
Mysore Agricultural Journal

Organ of the Mysore Farmers' Forum

Vol. XXXII *April to June 1957* *No. 2*

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COCONUT CULTIVATION IN SOUTH KANARA

(Cultivation of a Tree Which is Almost Worshipped as "*Kamadhenu*" and "*Kalpavriksha*")

By K. Sanjiva Shetty*

Introduction

Coconut (*Cocos nucifera*) occupied an area of about 5,58,000 acres in the residuary state of Madras comprising of 13 districts. Out of this, Malabar District accounted for 4,01,200 acres and South Kanara for 55,500 acres—these two districts occupied the first and second place in the matter of extent of coconut cultivation. It may therefore be seen that 83·5% of the total area under coconut in the old State of Madras was in the West Coast. The present area in South Kanara District excluding Kasargod, however, is 29,103 acres and the total area in the New State of Mysore is over 2 lakhs of acres. Therefore, this crop constitutes an important and integral factor in the economy of the West Coast *ryot*.

Climate.—Coconut is essentially a crop of the tropical region, although it is grown under a variety of conditions. It is cultivated in areas with varying altitudes, *viz.*, from sea-level to 3,000′. In India, coconut is grown in coastal belts, islands and in the Mysore plateau in soils which retain moisture and are well drained. Although it grows under a variety of soil conditions, it is necessary to select proper soil types so as to make the cultivation profitable.

Soil.—A right type of soil for coconut cultivation is one with a proportionate admixture of sand and clay with proper drainage. Big plantations are seen in red soil areas, along the banks of rivers and streams in sandy soils and along field bunds. In general, coconut thrives in areas with well distributed rainfall and in soils devoid of water stagnation. The soil should be well drained with subsoil moisture.

Types of Coconut Trees.—Generally speaking, there are two types of coconut trees—the *tall* and the *dwarf*. The usual West Coast tall variety lives upto about 80 years and yields good-sized nuts, copra, coir and oil as against the dwarf variety which although bears early, lasts only about 30 years, yielding small

* District Agricultural Officer, South Kanara.

nuts and therefore is uneconomical in the long run. Planting of *tall type* is more profitable and is recommended.

Seed Selection.—In perennial crops, seed selection is most important as against annual crops. For example, in the case of paddy or millets, if the proper type of seed is not sown in a year, the crops in that particular year may be bad and you have the option and chance of changing the seed for the next crop. It is not the case with crops that live for a number of years and begin to yield 6 to 8 years after planting. A mistake once committed at the time of planting, cannot be rectified after a number of years, unless you are prepared to cut down the whole plantation and start again. Look at the stupendous waste of time, energy and money consequential to raising a garden with unselected seednuts or seedlings! *It is therefore of the greatest importance that seednuts should be selected from trees of known parentage.* Write this in golden letters and follow it up meticulously, if you are to start a coconut garden on right lines. Now, how do you select the seednut!! *The parent tree* from which the seednut is to be selected should be middle-aged, regularly bearing not less than 100 nuts per year, with a well developed crown, without any drooping leaves. The average yield of a tree can generally be estimated by counting the number of nuts from the small buttons upto the ripe nut at any given time. The trees should not be in any favoured locality and the size of nut should be average, neither too big nor small. Trees which yield sterile nuts should be avoided. The selected nut should be of average size and 12 months old at the time of harvest. Nuts from the top and bottom of the bunch and those with cracked husk should be discarded. Nuts harvested from February to May are good for seed purposes. Seednuts should be lowered from trees by a rope and should not be dropped down. These can be stored for about a month till the outer husk dries a little. It is desirable to store the nuts in a bed of sand in which seednuts are placed with their eyes up and covered fully.

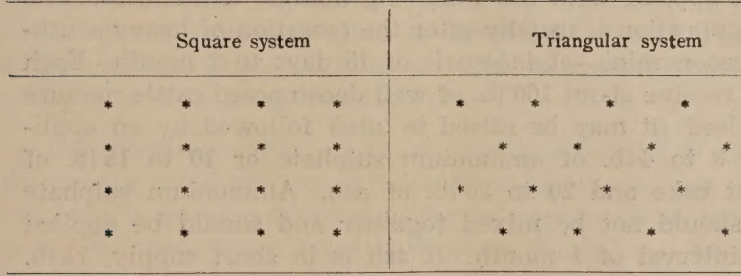
Raising of Seedlings.—A sandy soil close to a water source is desirable for raising the nursery. If sandy soil is not available, the soil can be excavated to a depth of 1½′ and the entire space filled with sand. This is necessary to assure proper drainage and avoid white ant attack. Seednuts are then planted in this prepared bed by placing them with their eyes on the top or in a little oblique position at about 1′ apart. The seed-bed should not be manured with cattle manure as it will attract white ants.

It is desirable to plant the seednut during the rainy season to minimise irrigation during the period of growth. Seednuts germinate from about the third month and the germination is completed in another 2 months.

Selection of Seedlings.—Apart from paying attention to the selection of seed-nuts it is also necessary to further select the seedlings from the nursery so raised. Seedlings that are robust and full of leaves, thick at the base, and full of roots should be selected. Seedlings that have germinated earlier are preferable to late-germinated seedlings. Seedlings in which the leaflets have split earlier indicates a better type of seedling. Paying attention to these points, select your seedlings after they are about a year old.

Method of Planting.—Full sunshine is very necessary for the proper growth of coconut plants. If seedlings are planted in a shady garden, the trees tend to become thin and elongated, and do not yield properly. Sixty to eight seedlings can be planted in an acre adopting a spacing of 25 to 30′ between plant and plant. In very fertile soils upto 100 seedlings can be planted in an acre.

Trees must be planted in lanes, either following the square method of planting or the triangular system. By the adoption of triangular system, about 10 more seedlings can be planted in an acre.



Spacing between plants	No. of Plants per acre	
	Square system	Triangular system
Feet		
24	76	87
25	70	80
26	64	74
27	60	69
28	56	64
29	52	60
30	48	56

Depth of Planting.—Pits 3′ cube are to be dug at the required distance. These should be dug about 3 months prior to the date of planting the seedlings. Dried leaves may be put in pits and burnt to avoid white ant attack. In lowlying areas, pits cannot be dug. Instead of digging pits, mounds should be raised 2 to 3′ high and the seedlings planted. At the time of ploughing, fill the pits with about 1′ of soil and apply 10 lb. of ash to each pit. The seedlings are then planted by covering the nut with well pressed soil and supporting the seedlings, if necessary, with props in a cyclone area. During summer, shade should be provided with coconut leaves. It is necessary to protect the plantation with a fence against cattle trespass. The seedlings should be irrigated during summer, once in 2 days during the first year and once a week thereafter. Care should be taken to control pests and diseases at every stage of the crop.

Catch Crops in Coconut Plantation.—During the early stages of a coconut plantation catch crops can be grown with considerable profit. As there is no income to the *ryot* at this stage, he can raise yams, tapioca, sweet potato, pulses, millets or dry paddy during the appropriate season.

Manuring.—Manuring is very important for a coconut crop and this need not be overemphasized. It is customary to apply green leaves or organic waste, burnt earth or ash to coconut plants. Apart from these applications, each adult coconut tree should be applied with the following dosage of manures. The time of application is usually after the cessation of heavy south-west monsoon rains—at *intervals* of 15 days to 1 month. Each tree may receive about 100 lb. of well decomposed cattle manure or green leaf (it may be raised *in situ*) followed by an application of 3 to 4 lb. of ammonium sulphate or 10 to 15 lb. of groundnut cake and 20 to 30 lb. of ash. Ammonium sulphate and ash should not be mixed together and should be applied after an interval of 1 month. If ash is in short supply, 1½ lb. of potassium sulphate or muriate of potash can be applied. It is also a good practice to apply coconut husk at the rate of 500 to 1,000 husks per tree in trenches dug between rows. These trenches may be about 6′ wide and 1½′ deep in which the husks are placed in two rows, one over the other facing upwards, so that these may act as a proper absorbent of rain-water. Apart from this, coconut husk contains a considerable amount of potash which is a useful manure to coconut tree.

Intercultivation.—It is necessary to intercultivate coconut gardens. The results at the Coconut Research Station, Kasar-

god, have shown that intercultivation alone has increased coconut production by 17%. A garden should be ploughed once in March-April with a view to conserve rain-water. In the month of September, the lands are to be ploughed again, and the manure applied in the proper order. In the month of December, one more intercultivation should be given to remove weeds. It must also be remembered that no other single factor or operation is as important as irrigation for a coconut crop. Therefore, irrigation should be done wherever it is possible to do so, although it has been possible to raise satisfactory coconut plantations under dry conditions with systematic manuring and intercultivation alone. At the Agricultural Research Station, Nileshwar III, where coconut plantations have been raised on a bare sand, the yield has been very unsatisfactory. Each tree was not yielding more than 5 nuts per year in spite of systematic intercultivation and manuring. At this station, irrigation was introduced with the help of filter points[1] mainly with a view to irrigate the coconut nursery, raised in between the coconut trees. Within a year, there has been a marvellous change in the performance of these trees and they are now found to yield more than 50 nuts per tree per year. It is therefore very necessary that coconut plantation should be started preferably in areas with assured irrigation sources.

Research and experiment has also shown that regular manuring and intercultivation as scheduled above has resulted in the yield of 60 to 100 nuts per tree as against less than 20 nuts per tree in a neglected garden.

Interplanting.—When a plantation is about 60 to 70 years old and the yield per tree falls to 10 or below, coconut gardens will have to be underplanted in the interspaces, with new seedlings. In areas where trees have been planted on the surface replanting may become necessary after 30 to 40 years.

Pests and Diseases.—Coconut tree is subject to several insect pests and fungoid diseases. Shoot-rot, bud-rot, and stem-bleeding diseases are common in coconut trees. Trees affected with shoot- and bud-rot will have to be operated by cutting away the affected portion just when the disease makes its appearance and the diseased part burnt. The operated portion should be applied with Bordeaux paste. Stem-bleeding disease can be controlled by scraping away the affected portion upto the healthy

[1] Shallow bore-wells.

tissue and burning away the affected portion. The operated portion of the plant should be applied with crude oil and tar. As this disease usually makes its appearance in ill-drained soil, trenches should be dug to drain stagnant water. Among insect pests, Rhinoceros beetle,[1] *Nephantis serinopa* (black-headed caterpillar) and white ants are usually met with. Rhinoceros beetle can be controlled by removing it as and when it is found, with beetle hook and filling the holes created by them with sand and an insecticide known as chlordane. Preventive measures like proper preservation of cattle manure in or round about coconut gardens are useful in minimising the multiplication of these beetles as the dung-heaps are the breeding places for these beetles. They can also be controlled or their multiplication inhibited by applying GAMMEXANE powder to dung heap or manure pits. *Serinopa* can be controlled by cutting the affected leaves and burning them. They can be also controlled by the biological method of releasing parasites for which a separate station has been established at Kasargod. White ant attack can be reduced by applying sand round the plants and applying crude oil emulsion at the rate of 1 lb. in 10 gallons of water.

According to the recommended methods of interculture, manuring and irrigation, the average cost of cultivation of a coconut tree is not likely to exceed Rs. 3 per year. But remember that a coconut tree raised with proper precautions is capable of yielding not less than 100 nuts per year which is valued at Rs. 15 to Rs. 20 at present market rates. Each tree is therefore capable of yielding a net profit of Rs. 12 to Rs. 15 per year. No other crop is so very responsive to proper treatment as a coconut tree. Every part of it is useful to human life and needs. The trunk is used as a building material. The leaves are useful for thatching roofs. The mid-rib is used as brooms. The leaf-sheath, the petiole and the spathe, the husk and the shell are all useful as fuel. The husk is the main source for the coir industry. Apart from yielding the nut for culinary purposes, coconut is an important oil seed crop which yields an excellent edible oil. The cake is a good cattle feed. Indeed coconut is a veritable *Kamadhenu*[2] or *Kalpavriksha*.[3]

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[1] *Oryctes rhinoceros.*
[2] Mythical cow of gods.
[3] Mythical tree of abundance.

(Received: 15th January 1957)

SOIL MOISTURE IN CHANNEL-IRRIGATED PADDY LANDS OF MYSORE DISTRICT DURING SUMMER MONTHS

By B. V. Venkata Rao*

Moisture is the main limiting factor in tropical agriculture. Agriculture in tropics is essentially seasonal and most of the crops are cultivated during the monsoon rainy season. Even these crops become uncertain on account of the vagaries of the monsoonal rainfall. At least, crops in limited areas are made certain by construction of dams across rivers and watercourses for the purpose of storing water and utilizing the same for irrigating the crops in the lower regions. Extensive network of channels emanating from dams and tanks is the unique feature of agriculture in this State. The river Cauvery is dammed at a number of places throughout its course and water is diverted into channels running many miles and irrigating thousands of acres of paddy lands in Mysore District. Such lands are under paddy cultivation for over 300 years.

The Paddy Breeding Station at Nagenahalli is situated 5 miles north of Mysore on Bangalore-Mysore Road. The lands are irrigated by the Devaraja Canal and is typically representative of the areas under old channel irrigation. The soils are sandy clays and well drained. Only one crop of paddy is grown during the months of July to December and the land lies bare exposed to the summer sun particularly from January to early April when light showers are received. The question of establishing a suitable cover crop in these areas, which can stand the drought conditions, is exercising the minds of people for a long time. *Kolinji*[1] is reputed to be a drought-resistant green manure crop grown extensively in the Cauvery Delta areas. An attempt was made to see if *Kolinji* could be introduced as a cover crop in between successive paddy crops by sowing the seeds in the standing crop before harvest some time in late November or early December. Water will be drained two weeks before harvest of paddy and the moisture conditions during this period and some time after that will be optimum for the germination and establishing of the *Kolinji* crop. If the crop could

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[1] *Tephrosia purpurea*, wild indigo.

get sufficient stand before the soil moisture dries up and is able to survive the dry period till rains in April, a solution to the problem will have been found.

Studies were started on this problem in 1954. A statistical experiment was laid out where *Kolinji* and other green manure seeds were sown in the standing crop of paddy before harvest. As a corollary to this, soil samples were collected from the plots at fortnightly intervals to determine the moisture content of soil as the summer advanced. In the tables below, the moisture content of surface soil and subsoils on different dates in 1955 summer as also on 15th March 1956 is presented. The mechanical composition of soil is also given.

TABLE I

Moisture content of surface and subsoil samples at Paddy Breeding Station, Nagenahalli, during summer months

(Percentages on oven-dry gravel-free material)

Description of plots	Date of sampling									
	31-1-1955		19-2-1955		11-3-1955		30-3-1955		15-3-1956	
Soil depth	0–6″	6–12″	0–6″	6–12″	0–6″	6–12″	0–6″	6–12″	0–6″	6–12″
1 Range VI A, Strip 5, Plot 4	15·2	18·0	18·6	18·7	5·8	13·6	3·4	7·6	4·5	8·4
2 Range VI A, Strip 4, Plot 1	4·9	13·8	11·0	10·4	5·5	8·1	6·6	5·0	5·5	6·2
3 Range VI A, Strip 4, Plot 6	14·5	26·2	19·6	21·2	8·6	10·8	5·0	7·6	7·0	4·2
4 Range VI A, Strip 1, Plot 3	8·6	13·3	15·4	19·3	3·9	13·3	2·5	9·5	4·5	6·8
5 Range III D, Strip 3, Plot 4	11·4	15·8	19·5	17·6	3·7	9·6	3·1	4·8	5·0	7·8
6 Range III D, Strip 4, Plot 5	7·2	23·4	9·9	18·3	2·5	7·8	3·3	3·3	5·0	8·0

Note.—The fields were given a light irrigation on 8-2-1955.

A perusal of the data, relating to moisture contents, shows that the moisture in surface soil gets very low as the dry season advances. Unless plants have established well and are able to feed on subsoil moisture, they are bound to die for want of moisture. Even the subsoil moisture in the month of March cannot be considered to be adequate to a vigorous crop and the crop is likely to suffer, though it might have made good progress in the earlier stages. The several green manure plants which had made some progress after germination did not make any further progress in March and began to wilt. In the absence

of irrigation at intervals, it does not seem to be possible to establish a cover crop during dry months in the paddy lands irrigated by the channels as represented by soils at the Paddy Breeding Station.

TABLE II

Mechanical composition of soils

	Surface Soil					Subsoil				
	Gravel	Coarse sand	Fine sand	Silt	Clay	Gravel	Coarse sand	Fine sand	Silt	Clay
1 Composite sample of VI A, Strip 4, Plots 6 and 1	77·0	40·8	29·4	0·7	24·7	74·4	27·6	18·9	4·5	48·5
2 Composite sample of VI A, Strip 1, Plot 3 and Strip 5, Plot 4	26·1	42·7	30·6	5·8	20·0	27·7	38·2	20·7	1·2	37·4
3 Composite sample of III D, Strip 3, Plot 2 and Strip 4, Plot 5	25·0	39·7	37·7	0·9	19·1	48·2	42·9	17·4	1·1	35·0

Moisture content at sticky point of the soil is 12·5, soil *pH* 5–5·5.

SUMMARY

In this paper, studies on soil moisture status in the paddy lands during the months of January, February and March when there will be no water available for irrigation, are reported. The object of the study was to ascertain whether the moisture in soils in the absence of irrigation facilities would be sufficient to support a cover crop like *Kolinji* which can occupy the land during the off-season and serve as a green manure to the paddy crop in the monsoon season. The soils are found to dry up and the moisture in them will not be adequate to support any crop, particularly in the month of March which is the driest period of the year in these parts.

The encouragement afforded for this study by Dr. S. V. Govinda Rajan, former Agricultural Chemist, and now Soil Correlator, Red Soils Region, is gratefully acknowledged. Acknowledgements are also due to Sri. B. Bheemasena Rao for facilities and interest in the work. Thanks are due to Sri. K. Shankar and Sri. S. Shamanna for assistance in analytical work and to Sri. A. Krishnaswamiengar, Junior Assistant Botanist, Paddy Breeding Station, Nagenahalli, for co-operation in periodic collection of soil samples.

(Received: 19th January 1957)

THE NEED OF WOODED LANDS (*SOPPINA-BETTA*) FOR ARECA GARDENS

By Kanale Krishna Murthy*

It is not that the areca cultivator in *Malnad*[1] has encroached the wooded lands for converting it into arable lands or for his fire-wood. But the very location of the areca gardens has an unique significance. The place that is most suitable for areca gardens to thrive is an almost level ground between two wooded hillocks, *i.e.*, valley, because such a place will be well protected against wind and sun scorching, and is capable of maintaining a humid atmosphere and retaining moisture in the soil. Also these wooded lands help to maintain the garden by supplying green manure.

It is an accepted scientific principle that green manuring either brought from or grown *in situ* has many advantages of its own. But it is an age-old and time-honoured experience of areca cultivators to use green and dry leaves along with the twigs of forest trees for maintaining his gardens. It is by virtue of such necessity that the areca cultivator should maintain his forest in good condition.

For the normal growth of every plant, certain elements, *i.e.*, nitrogen, phosphorus, potassium, calcium, sulphur, iron, boron, etc., are essential—may be in large quantities or in traces. Such elements which are required as traces do not mean that they are less essential than the so-called primary elements. Though each of these plant foods has a special role, all are required in adequate quantities and proper proportions for normal growth. In the total absence of any one of these elements, the full development of the plant will be affected, which consequently does not give good yield.

It is a well established fact that by the addition of fertilizers such as ammonium sulphate, superphosphate, etc., there will be increase in crop yield for a certain period due to their quick action. But it should not be thought out that the use of fertilizers will enable the cultivator to avoid the effort in collecting and preparing farm manure. Fertilizers have a definite

---

* Farmer, Sagar, Shimoga.

1 Hilly country in West Mysore.

place in crop production. Due to continued application of fertilizers, such as ammonium sulphate, superphosphate, etc., the soil will be depleted of other trace elements, which are not added along with these fertilizers. Moreover, it is not possible by an ordinary cultivator to add each of these trace elements in balanced proportion. Hence even though the fertilizers supply the important plant nutrient, they cannot replace the bulky organic manures.

Though the amount of each nutrient in bulky organic manures, such as farmyard manure, compost, green manure, are comparatively less, they supply all the nutrients necessary for plant growth. Moreover, the bulky organic manures are not applied merely for the sake of plant food. They have the other functions to perform in the soil. They improve the texture and increase the water-holding capacity, which these fertilizers cannot do. A continuous use of the fertilizers alone may turn out to be more harmful than beneficial. Fertilizers are meant to supplement the organic manure. It is by the application of both organic manures and fertilizers in their right proportion, that the farmer can think of a good yield.

For maintaining soil fertility, adequate quantities of humus, nitrogen, phosphorus, potash and other trace elements are essential under tropical climate such as ours where humus is lost due to rapid oxidation. For this purpose, maintenance of proper supply of organic matter is of great importance. Farmyard manure, compost and green manures supply organic matter. But cowdung is largely burnt as fuel. Similarly, leaves, etc., are burnt for *rabbing*[1] the seed-bed as well as for fuel. Therefore, green manuring is the only solution, the cheapest and most suitable method by which we can add humus and other plant nutrients to the soil in order to increase and maintain its fertility.

What is Green Manuring ?

Green manuring is a practice of turning into the soil undecomposed green plant materials such as leaves, twigs, etc., either brought from outside or grown *in situ*. This has many beneficial effects. It supplies almost all the nutrients (even trace elements) for the growth of plants. Tilth is never satisfactory unless the organic matter is upto a certain level and this is supplied by green manure. It increases the water-holding capacity.

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[1] Burning cowdung and brushwood on the nursery bed.

Activities of the micro-organisms increase, which in turn make the soil fertile by fixing nitrogen, sulphur, etc. The residue of the organic matters, called humus, plays an important role in the maintenance of soil fertility.

But this growing *in situ* and turning into the soil for decomposition is possible only in field crops such as paddy, sugarcane, wheat, etc. It is not possible in the case of plantation crops such as arecanut.

Green Manuring in Areca Gardens

In *Malnad,* each cultivator divides his entire garden into three portions and manuring will be done by rotations. After manuring and other intercultural operations, the green manures such as green leaves and twigs of selected trees, such as *Matti* (*Terminalia tomentosa*), *Yekka* (*Calotropis gigantea*), *Kavalu* (*Careya arborea*), *Nelli* (*Phyllanthus emblica*), *Neem* (*Melia azederach*), *Honge* (*Pongamia glabra*), etc., are brought from wooded lands (called as *Soppinabetta* in Kannada), during the months of September-October, and will be spread in rows upto a thickness of 1½-2′ (see Fig. 1). In this case, it will not be turned into the soil for decomposition, as the digging operations cannot be done so deeply as to bury the leaves underneath the soil. The leaves will fall on the surface of the soil itself and there the decomposition takes place gradually.

Another thing is, during monsoon (May-June), the dry and green leaves are brought from the wooded lands and spread in the manure pit in alternate layers with cattle dung, ash and farm wastes. This, after three or four months, *i.e.,* September/October, when the decomposition will be completed will be transferred to the gardens. This type is somewhat akin to compost and may be called as "fermented green manures".

Reasons for Adopting This Method

(1) Areca gardens are mostly situated by the sides of the hills which are slopy. Due to heavy and torrential rains the upper layer of the soil will be washed away due to soil erosion (see Figs. 2 and 3). In order to check soil erosion, the leaves and twigs are spread at a thickness of 1½-2′.

(2) During summer this acts as a soil mulch and the evaporation will be reduced.

(3) The growth of weeds will be lessened.

FIG. 1

FIG. 2

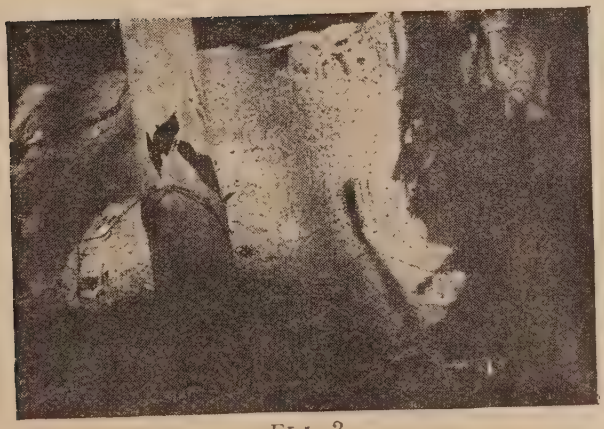

FIG. 3

FIGS. 1–3. *Soppinabetta*.

(4) Some green leaves such as *Neem, Honge* (*Pongamia glabra*), due to their astringency (bitter principle) keep away some of the insect pests.

(5) Some green leaves like *Neem, Mathi, Yekka, Kavalu, Nelli* and mango are specially known for correcting the alkali soils.

In addition to these, they have the same effects as that of green manure, which are used in other fields.

Apart from these, the cultivator should have to apply, once in eight or ten years, new soil cut and brought from wooded lands for *Bharns* (a type of ridge) and once in three years for rows. This increases the crop yield by adding heavy amount of organic and inorganic nutrients and maintaining soil moisture.

Difficulties in Growing Green Manure Crop *in situ*

It is a well known fact that manuring with green manurial crops has many beneficial effects. The growing of green manurial crops *in situ* is mainly practised where paddy, sugarcane, wheat, etc., are grown. But the cultural practices do not permit this system to be adopted in areca gardens.

The reasons are :—

(1) In areca gardens, the ploughing is impossible and digging operations are done once in eight or ten years, that too, just after monsoon. Therefore, the green manure crop will not establish well in such unploughed lands.

(2) As the gardens are mostly situated in places where rainfall is heavy, most of the green manuring plant will rot due to heavy rain and water drippings.

(3) The green manuring plant will be ready for turning into the soil during October/November. But the cultural practices such as digging, replanting, manuring, renewing of soil, etc., starts long before, *i.e.,* August-September.

(4) Falling of the old leaves of areca palm and collecting it causes the green manuring plant to break and hence will not make good growth.

(5) The subsidiary crops such as cardamom and pepper cannot withstand the digging operations every year and even so the areca palm ; therefore, the growing of green crops *in situ* and burying in the soil is impracticable.

(6) It is necessary to cover the rows with twigs, and leaves upto a thickness of 1½-2′ in order to check soil erosion, as against growing green manuring plant, *in situ* which is insufficient in this particular case.

Above all, the green and dry leaves are essential in preparing the compost and fermented manures. Therefore, this and the above facts go to prove the necessity of wooded lands in the cultivation of the areca gardens.

The wooded lands (*Soppinabetta*), are mainly essential for the cultivation of areca gardens in *Malnad* parts. The holding of an individual areca cultivator is much less in India as a whole, and in order to get maximum yield out of minimum holding, the only way is through intensive cultivation, which indirectly stresses the necessity of wooded lands for green manure. In considering these facts, both the Government of India and the Local Government have all along attached greater importance to the preservation of wooded lands as the means of maintaining a humid atmosphere and moist soil which is so essential in the cultivation and maintenance of *supari*[2] gardens. "Leaf manure," as Mr. Madhava Rao, the then Dewan of Mysore, aptly observed, "is the life and soul of *supari* industry and we cannot do better in ensuring a perpetual supply of it to the gardens, than to set apart portions, from which alone the owners could draw their supply and which it would be their vital interest not only to prevent from destruction or deterioration, but to cultivate and improve." Further, the Deputy Commissioner, Shimoga District, in 1887, in one of his correspondence said, "Leaf manure is the life and soul of *supari* cultivation, and in this alone there is every guarantee for the trees not being recklessly cut down. But as a fact in *Soppinabettas* allotted to each *Khatedar*[3] separately, it has been found not only that trees are carefully preserved but also trees are newly planted to ensure a constant supply of leaf manure. The *supari* garden owners take the greatest possible care with their *Bettas* and considering the heavy assessment they pay, it is only fair that they should have the small additional privilege above recommended. Above all, the sense of private property which will arise will be of incalculable benefit in preventing indiscriminate falling and in conserving these forests."

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[2] *Supari* = areca.

[3] Landholder.

The above facts prove that assignment of *Soppinabetta* to areca gardens in adequate ratio is of great necessity.

Recommendations

One acre of areca garden requires ten acres of wooded lands for the supply of green manures. This the cultivator can divide it into 3 parts and the leaves can be cut from each section by rotation and used for manuring. But this has not been adequately granted. Therefore, the grant of adequate area is an urgent need.

There are no separate wooded lands for paddy and other crops, and hence there is much pressure on these lands, which in turn make the forest denuded. Hence the grant of separate wooded lands for paddy and other crops is necessary.

As there is no assignment of wooded lands for areca gardens and so there is no restriction against indiscriminate cutting of trees and also there is no encouragement for husbanding trees ; therefore, the lands are denuded very early. Therefore, assignment is necessary.

The wooded lands are scattered and situated far away from the areca gardens. This increases the cost of cultivation and hence assignment of wooded lands at a more convenient place is a matter of great importance.

Researches in regard to the manurial, agronomic and economic problems are essential.

Acknowledgement

Acknowledgements are due to Sri. K. S. Muddappa for his kind assistance.

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SOME FACTORS RESPONSIBLE FOR THE INCREASE IN THE INCIDENCE OF THE RICE STEM-BORER (*SCHŒNOBIUS INCERTELLUS* WLK.) IN RECENT YEARS IN HYDERABAD[1]

By M. Q. Khan[2] and D. V. Murthy[3]

Introduction

The rice stem-borer *Schœnobius incertellus* Wlk. is a major insect pest of the rice crop in the Indian Union. It is only since the year 1950 that the stem-borer has assumed epidemic proportions in the perennially irrigated zone of the Nizamabad District, Hyderabad State. The incidence is heavy, especially on the second crop that is grown from December to May. The present note deals with some of the factors responsible for the increase in the incidence of *Schœnobius incertellus*.

Seasonal History

Due to the availability of irrigation water, two crops of rice are grown on same lands, the first is the *Abi* and the second, *Tabi*. The *Tabi* is grown during December-January to April-May. In Nizamabad District, especially in the perennial zone, the *Abi* crop is almost invariably transplanted while the *Tabi* crop is generally sown broadcast. The *Abi* crop has the benefit of the South-west Monsoon rain which averages 35 to 40", which washes off the *Schœnobius larvæ* on hatching.

Five to six broods of *Schœnobius incertellus* are observed in an year. After the harvest of the *Abi* crop, the pest remains in the stubbles mostly in the larval stage. The migrant moths from the stubbles of the *Abi* crop are observed in the early sown *Tabi* nurseries and broadcast crop.

Factors Responsible for the Increase in the Incidence

Tsai (1936) observed that the outbreak of *Schœnobius* is favoured by a hot rainy autumn or a warm dry winter. Ayyar

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[1] Paper presented at the Fifth Session of the International Rice Commission, Calcutta, November 1956.

[2] Government Entomologist and Plant Protection Officer in former Hyderabad State.

[3] Assistant Entomologist, Hyderabad State, now assigned to Mysore State.

AND ANANTHANARAYANAN (1937) working on *Schœnobius incertellus* in South India, observed that the important factors influencing the incidence of the pest were, primarily, moth abundance and climatic conditions.

In Nizamabad it has been observed that the incidence of *Schœnobius incertellus* is less in *Abi* when the mean minimum temperature is from 64 to 78° F. and the mean maximum temperature is from 84 to 96° F. and the mean humidity is 65 to 89%. In *Tabi,* the incidence of the pest is high. During this season, the mean minimum temperature varies from 56 to 78° F. and the mean maximum temperature 84 to 101° F. and mean humidity 54 to 83%. This shows that high temperature and low humidity are favourable for the breeding of the stem-borer.

The natural enemies of *Schœnobius incertellus* in Nizamabad District are the egg-parasites *Trichogramma evanescens minutum, Tetrastichus schœnobii* Ferr and *Telenomus beneficiens,* and a braconid pupal parasite (still to be identified). The parasitisations of the egg-masses average to less than 10%. The egg-parasites are active in *Abi* only.

Besides the favourable weather conditions and the low parasitization of the egg-masses of the borer in nature, the other important factor which is responsible for the increased multiplication of the pest is large-scale adoption of long-duration varieties in *Abi.* Prior to 1950, the common practice was to grow early-maturing varieties of 90-120 days' duration. These varieties come to harvest in the end of October, which made it difficult for the stem-borer to get a continuous supply of plant food. After 1950, early-maturing varieties were replaced by late-maturing ones in *Abi.* Thus the stem-borer found food material for longer activity. This is reflected in the increased incidence of borer attack at harvest in the late-maturing varieties as compared to the early-maturing ones. In Tables I and II are given the average numbers of stem-bored earheads (index of borer attack) at harvest in some varieties of rice in *Abi.*

The data show that the late-maturing strains, RDR. 4 and HR. 85 have recorded significantly a higher number of stem-bored earheads at harvest.

The important factor contributing to the increase in the numbers of *Schœnobius incertellus* is the shortening of the interval between the first and the second crop season by growing

late-maturing varieties in the first crop season. Not infrequently it is seen that the nurseries for the second crop are being raised when the late-maturing varieties of the first crop are still standing in the field. This gives the chance for the pest to change over from the first season crop to the second season crop without difficulty.

TABLE I

Showing the number of stem-bored ears at harvest in different varieties of rice during first crop season 1949

Variety	Maturity period	Range of stem-bored ears in a 3′ square unit at harvest in cultivators' fields (based on large numbers of observations)
HR. 19 ..	(125 days)	1·0–3·5
Rajgarkal ..	(95 days)	0–3·0
Buddagarkal ..	(95 days)	0–2·0
HR. 35 ..	(175 days)	4·0–5·0

TABLE II

Showing the number of stem-bored ears at harvest in different varieties of rice during first crop season 1955-56

Variety	Maturity period in days	No. of S.B. ears in 10 numbers of 3′ sq. units					Mean
		R. 1	R. 2	R. 3	R. 4	R. 5	
HR. 8 ..	130 (Early)	20	45	61	54	35	43·0
HR. 19 ..	125 (Early)	21	54	24	26	23	29·6
HR. 22 ..	130 (Early)	31	70	62	75	76	62·8
Basangi ..	150 (Late)	34	35	28	26	33	31·2
RDR. 4 ..	165 (Late)	89	106	103	92	97	97·4
HR. 35 ..	175 (Late)	120	74	91	96	64	89·0

Remarks—Observations were carried out in a varietal field experiment of plot size 50′ × 22′. The number of replications were 5. In each plot, ten numbers of 3 square units were located at random with the help of a list of pair of random numbers giving an approximate sampling of 10%.

The second season crop is more attacked by *Schœnobius incertellus* in view of the 'build-up' of the pest in the late-maturing varieties in the first crop season as seen from Table III.

The 'build-up' of the pest results in the higher deposition of the egg-masses by the first generation moths in the second crop season, as compared to the egg-deposition of the subsequent generations.

Table III

Showing the number of bored earheads at harvest in different varieties of rice during the second crop season 1955-56

Sr. No.	Variety	No. of bored earheads in ten 3′ sq. units					Mean
		R. 1	R. 2	R. 3	R. 4	R. 5	
1	HR. 67 ..	734	824	753	262	437	602·0
2	CH. 45 ..	429	504	448	177	264	364·4
3	HR. 19 ..	897	924	711	251	485	653·6
4	HR. 12 ..	875	850	639	241	413	603·6
5	RDR. 7 ..	673	744	670	177	407	554·2
6	RDR. 2 ..	676	715	607	233	512	546·6

Remarks.—Observations were carried out in a varietal field experiment of plot size 50′ × 22′. The numbers of replications were 5. In each plot, ten numbers of 3′ square units were located at random with the help of a list of a pair of a random numbers giving an approximate sampling of 10%.

Summary

There has been an increase in the incidence of the rice stem-borer, *Schœnibius incertellus* on the second seasonal rice crop sown in December-January in the perennially irrigated *talukas* of the Nizamabad District since 1950. An attempt to trace out the causes show that the mass-scale adoption of late-maturing varieties in the first crop season since 1950 is the primary factor responsible for the increased incidence on the succeeding second crop as the vital gap between the first and second crop season is extremely shortened.

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TOMATILLO OR THE MEXICAN HUSK TOMATO*

By L. Venkataratnam§

Tomatillo or Mexican Husk Tomato (*Physalis ixocarpa* Brot) belonging to Solanaceæ is a new vegetable originating from Mexico. It is scattered all over the high lands in Guatemala and Mexico where the fruits are commonly seen in native markets. This plant is an annual and resembles Cape Gooseberry[1] in vegetative characters. The fruit attains 2" or more in diameter and protrudes out of the straw-coloured calyx or husk at the tip, unlike Cape Gooseberry where the berry is loosely enclosed by the calyx. When ripe, the fruit develops golden yellow colour. The flesh is pale yellow, crisp, glistening, mildy sweet and subacid. The fruit resembles tomato in cross-section and is often mistaken for a small tomato. On account of its close resemblance to tomato, this has been named Tomatillo. It is also called Mexican Husk Tomato owing to the husk-like calyx enveloping three-fourths of the fruit and due to its origin from Mexico. About two decades back, this species was brought into cultivation in Mexico. A few enterprising growers named this as Jamberry and introduced this plant in Ecuador.

Dr. Melhus, Director of the Iowa State College,[3] developed a strain from this Mexican Husk Tomato and gave the name Mayan Husk Tomato. In 1953, this was introduced in Miami, Florida, by Julia F. Morton.[1] Now, Mexican Husk Tomato is fast becoming a popular fruit in Florida.

Seeds of Mexican Husk Tomato were imported by the author for trial under Indian conditions. The crop has given good performance, both in the *kharif* as well as in the winter season. In view of its promising features, brief hints on its cultivation are outlined below :—

Hints on Cultivation

The cultivation of this crop is similar to that of tomato and practically the cultural technique does not differ from that of

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[1] *Physalis edulis* or more correctly *Peruviana edulis.*

tomato. Seeds are sown in raised beds and three-week-old seedlings are transplanted at 2′ distances either way. An ounce of seed is adequate for raising an acre of crop. The seeds are very minute and resemble that of Cape Gooseberry. The seeds should be mixed with plenty of sand and sown in lines in order to ensure uniform distribution of seeds. June and October to December are found suitable months for raising the crop.

The seedlings grow to a height of 1′ in a month's time. Flowering commences 5 weeks after transplanting. The flowers are about 1 cm. in diameter and occur in extra-axillary clusters. The branches spread horizontally and show prostrate habit. In about 10 weeks' time after planting, the plants attain 2 to 3′ height and commence bearing. The harvest continues for about 6 weeks. Each plant bears 20 to 30 fruits and each fruit weighs roughly an ounce. An acre yields 15,000 to 20,000 lb. of fruits. The mature fruits drop immediately after they ripen and hence daily picking of fruits is necessary.

Mayan Husk Tomato is a very hardy plant and very few pests and diseases affect this crop. It is resistant to many of the virus diseases that commonly affect tomato and other solanaceous crops. Very few fungoid diseases have been recorded on this crop except leaf-spot disease which has been occasionally noticed. The freedom and ease with which this crop can be grown offers considerable scope for introducing this crop in our conditions. A few pests are reported to attack this crop. Cutworms are reported to have occurred in Florida, but in Hyderabad, cutworms were not found to affect the crop. There was incidence of stem-borer and fruit-borer during heavy rains. The winter crop is free from any attack of pests. Due to the thick pubescence on the underside of leaves, the crop is resistant to fungus diseases.

Uses

Mexican Husk Tomato is a good salad vegetable and the fruits can be eaten raw like ripe tomatoes. It possesses crisp flesh, mild acidity with pleasant flavour. This is reported by Munsell Williams[2] to be a good source of iron, calcium and phosphorus and an excellent source of vitamin C. As a vegetable, it can be used for curry, pickles and soups. A good jam can be made from this fruit and owing to the attractive nature of the jam derived from this fruit, Mayan Husk Tomato is otherwise called **Jamberry**.

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FIG. 1. Tomatillo or Husk Tomato.

FIG. 2. A branch showing the fruits of Tomatillo.

PROBLEMS OF DRY FARMING AND SOIL CONSERVATION IN NEW MYSORE STATE

By S. S. Sirur*

It has by now been generally recognised that conservation of the soil and water resources is an essential prerequisite in planning for the agricultural development of any region. In the areas of the Old Mysore State, these problems were not probably very acutely experienced due to the fairly assured nature of the rainfall over the major part of the State. Another factor was the development of irrigation which was undertaken on an extensive scale with the construction of a large network of tanks and also a number of major irrigation works.

It was also possible that, with the generally small size of the holdings which were usually separated by marginal bunds, the problem of soil and water conservation in the rain-fed areas was considerably minimised. However, the occurrence of large-scale soil erosion has been observed, particularly from uncultivated lands which has manifested itself in extensive gully and ravine formation and the silting up of tanks. Mr. Ford M. Milam, Technical Specialist assigned to the ICAR, New Delhi, who undertook an inspection tour of the Mysore State in May 1951, has made the following observations in his report :—

"In parts of the Mysore State, I observed soil erosion on a very extended scale. The most noticeable erosion is taking place on old pasture lands and abandoned areas. It seems that these areas are not under the strict control of any one and are, more or less, neglected. It was very evident that this erosion which was taking place on these lands, is causing considerable damage to valuable farm lands and irrigation tanks in the surrounding districts." Mr. Milam has accordingly made the following recommendations in his report. "Effective soil conservation programmes must be planned in such a manner whereby good farm management and land use practices are carried out not only to conserve the water and soil but to maintain fertility as well." He states further, "If soil conservation is to be effective, Government must provide funds, qualified personnel and facilities to carry out the work. Secondly, a very

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intensive propaganda campaign must be carried out to awaken the people of the State to the need of services of this nature.... Every piece of research data or information available which tells a soil conservation story, should be utilised in this propaganda programme."

With the addition of several districts from the Bombay, Hyderabad and Madras Karnatak areas to the Mysore State, these problems have assumed a greatly increased significance for the New Mysore State. It is well known that larger or smaller parts of these districts, particularly of those situated in the northern and eastern parts of the State are liable to periodical scarcity and famine on account of the low and uncertain nature of the rainfall. Thus, together with similar areas in the erstwhile Mysore State, there is an extensive tract of such nature constituting the "problem areas" of the State. The problem in this region is two-fold, involving the conservation of water and soil. A considerable proportion of the rain-water, already scanty and uncertain, is liable to losses through surface run off on account of the sloping lands and low permeability of the soil, a large quantity of soil being also removed during heavy downpours.

These conditions have led to the gradual deterioration of agricultural conditions on account of uncertain crop harvests and periodical scarcities. As a remedial measure, protective irrigation works have been constructed in some of the States but by far the larger proportion of the area has to depend on methods of dry farming for reducing the hazards of successful farming under these conditions. In most of these States, a considerable amount of work, both on research and development, has been carried out on problems of soil conservation and dry farming, which has been briefly described below in order to point out the necessity and the possibilities of similar work to be undertaken in the areas of Old Mysore State and in the New State as a whole.

In Bombay State, the problem of dry farming was taken up as early as 1923 at a small research station at Manjri near Poona. It was soon realised that the problem was complicated and many-sided and with the constitution of the Indian (then Imperial) Council of Agricultural Research (ICAR), in 1920, the matter received the active support and encouragement from that body resulting in the establishment of co-ordinated schemes of dry farming research in the states of Bombay, Punjab,

Hyderabad and Madras. These schemes were in existence during the period from 1933 to 1943 when comprehensive investigations were conducted with reference to the vital question of soil and water conservation and the improvement of agricultural practices for the staple crop in each of the regions. The work conducted in these research stations has been described in a monograph of the ICAR entitled, *Dry Farming in India,* by Dr. N. V. Kanitkar.

The investigations in Bombay, Hyderabad and Madras States, parts of which have now merged in Mysore State, led to the formulation of improved dry farming methods. The main principles involved in these methods for the purpose of soil and moisture conservation and for the improvement of crop yields were : (1) the construction of temporary or permanent bunds or embankments in the fields on the contour, (2) all cultural operations to be also done along the contour, (3) selection of soil of suitable depth or texture for sufficient moisture conservation, (4) growing of drought-resistant varieties of crops, (5) employment of wider sowing and lower seed rate, (6) improved cultural practices involving newer implements and optimum time and number of operations, (7) application of at least a minimum quantity of farmyard manure, and (8) suitable crop rotations for keeping up the soil fertility. The Bombay dry farming method, when all these measures were combined, was found to be capable of giving consistently 2 to 2½ times the yield of *rabi* or *hingari* jowar as compared with the usual cultivator's method in unbunded fields. In the other States also, appreciable increases in yields were obtained by adopting the improved methods.

In the Bombay State, the investigations which were originally conducted on the main research station at Sholapur representing the trap soils of shallow to medium depth of the dry areas of Deccan and on the sub-station at Bijapur representing the deep black soils of Bombay Karnatak, were extended to different soil climatic zones within the dry tract. The work was also considerably expanded in scope by taking up investigations on various other aspects of soil conservation problems. Extensive soil erosion surveys were undertaken in the Deccan and Karnatak regions for assessing the extent of past erosion and its effects on the properties and crop-producing power of soils. Studies on the vegetative methods of soil conservation were carried out including the soil-conserving

power of different crops and grasses which led to the development of a 'strip cropping' technique. The reclamation of saline lands which naturally occur in semi-arid climatic conditions was also undertaken with special reference to the *karl* soil of Karnatak.

At present, comprehensive long-term investigations are in progress under the two broad heads of agronomy and soil chemistry. Studies for modifying the dry farming method and for further improvement in the crop yields according to the variations in soil and climate in different parts of the dry tract are being made. In these latter investigations, it has been found that due to the gradual improvement in soil-moisture status, physical conditions and fertility of the soil brought about by bunding and continued dry farming practices, there is great potentiality for further pushing up crop yields by the application of nitrogenous and phosphatic manures. The improvements in the agricultural techniques which were indicated as a result of the research work were incorporated from time to time in revised editions of the leaflet on dry farming of the Bombay Department of Agriculture for distribution among cultivators. The latest proven conclusions of the research work, including the strip-cropping technique suitable for *mungari* crops are described in Leaflet No. 1 of 1952 of the Bombay Department of Agriculture. The investigations on dry farming and soil conservation which were in progress in different States subsequent to the termination of the original dry farming research schemes in 1943 have also been compiled in a *Supplement to the Monograph on Dry Farming*, by S. S. Sirur and D. H. Gokhale which is under publication by the ICAR.

In the field of extension and development, varying extent of progress in undertaking works on anti-erosion measures, such as contour-bunding has been achieved in the different States. Substantial progress has been achieved in this direction by the Bombay State where contour-bunding has been so far completed over about 15 lakh acres and the work is being continued on a large scale during the Second Five-Year Plan. Efforts have also been in progress in the different States to popularise the improved dry farming methods among the cultivators.

A significant development for bringing home the results of research work to the cultivators and convincing them of the utility of the improved methods has been the scheme started

in Bombay State under which about 300 demonstration plots were laid out in 1955 on cultivators' fields on a guaranteed basis. The demonstrations consisted of growing of *rabi* (*hingari*) jowar on an area of 10 to 20 acres, half of which was grown according to the improved method advocated by the Department. The other half was cultivated according to the cultivators' usual method and served as a control plot. The work was taken up on the basis of a guarantee that the cultivator would be paid compensation of loss, if any, which he sustained by adopting the improved method against his own. It was found that no compensation had to be paid in any of the cases as the improved dry farming method invariably proved to be superior.

A considerable part of all the abovementioned work, including certain existing research centres and schemes of research and development either already in operation or proposed to be started have come over to the new State from the merging areas which are listed below :

1. Dry Farming and Soil Conservation Research Station, Kaladgi (Dist. Bijapur).
2. Dry Farming and Soil Conservation Research Station, Saundatti (Dist. Belgaum).
3. Soil Reclamation Research Station for *Kar*l Soil of Karnatak, Nargund (Dist. Dharwar).
4. Soil Reclamation Laboratory, Agricultural College, Dharwar.
5. Dry Farming Research Centre, Raichur.
6. Dry Farming Research Centre, Hagari (Bellary Dist.).
7. Scheme for Research on Local Problems (Research for Bunding in Deep Black Soils), North Karnatak Districts).
8. Scheme for Rotational Grazing, Coorg.
9. Scheme for Introduction of Dry Farming Methods in Bunded Areas.

There is also the Soil Conservation Research, Demonstration and Training Centre of the Central Government started by the Central Soil Conservation Board at Bellary, where fundamental work pertaining to the region as a whole is being undertaken. Schemes for soil conservation in forest areas by means of afforestation and engineering methods on hill slopes are also proposed to be taken up by the Forest Department in Old Mysore and Coorg areas.

In addition to all these, large-scale works on contour-bunding are in progress and are being continued on an expanded basis during the Second Five-Year Plan period in the merging areas, particularly from Bombay State. Similarly, the following schemes for research and development in soil conservation have been proposed for areas of the Old Mysore State during the Second Five-Year Plan :—

1. Scheme for Research and Survey in Soil Conservation.
2. Scheme for Demonstrations in Soil Conservation.
3. Scheme for Soil Conservation Projects in Agricultural Lands.

Thus it may be seen that a good nucleus already exists in the New State for carrying out intensive activity in soil conservation. There has been a lack of detailed fundamental research on soil conservation problems pertaining to the areas of Old Mysore State which possesses different distinctive conditions of soil, climate and other factors resulting in different soil erosion patterns. All these would have to be studied in detail in order to determine the causes, nature and extent of erosion and to arrive at suitable methods of control. For this purpose, it would be necessary to have, in the first place, an efficient research organisation which would be entrusted not only with the carrying out of primary research for the areas of Old Mysore but also with the work of over-all guidance and supervision of the research work in other centres and schemes. Finally, by suitably co-ordinating the research and development work it would be possible to have a comprehensive and integrated activity for tackling the various problems of soil conservation in the State.

It may be confidently hoped that such intensive and long-continued activity in all aspects of soil conservation in areas of both low and high rainfall would ultimately lead in a large measure to the conservation of the soil and water resources of the State and thereby to the improvement and maintenance of agricultural production at a high level.

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STUDIES ON FIELD RELEASES OF *TRICHOGRAMMA EVANESCENS MINUTUM* RILEY FOR THE CONTROL OF THE *JOLA* STEM-BORER, *CHILO ZONELLUS* SWINHOE

By Dr. M. Puttarudriah* and S. Usman§

Introduction

Jola (*Sorghum vulgare*) is a staple food crop in the northern districts of Mysore, and the stem-borer, *Chilo zonellus* Swinhoe, is one of its major pests. The release of *Trichogramma evanescens minutum* Riley and light earthing up experiments against the stem-borer were undertaken at the Agricultural Research Station, Hagari, Bellary District, during the last three years 1954-55 to 1956-57, and the results obtained are recorded in this paper. It appeared from previous records that in the past *Trichogramma* was released against this pest in a plot of 0·3 acres at 20,000 parasites per acre every time for a period of three months in the same Farm during 1949-50 by the Madras authorities (when the Station was under their control) but that their data did not lead to any definite conclusions.

Thanks are due to the Superintendent and the Staff of the Agricultural Research Station, Hagari, for their wholehearted co-operation and help in the conduct of these experiments.

II. Material and Methods

Hingari[1] *bili jola* grown in October-March is the main *jola* crop in Bellary District, and these experiments were conducted in this crop and timed when it was 1 month old. In the first year four plots of 2 acres each were selected, two plots near the laboratory and the other two about ½ mile away near the staff quarters : in the first series *Trichogramma* parasites were released in one plot, in the other plot both *Trichogramma* release and light earthing up were done for studying the combined effect as against parasite release only ; and in the second series, light earthing up was undertaken in one plot and the other plot received no treatment and formed the control plot.

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[1] Late season.

During the subsequent 2 years, in order to ensure a more uniform stand of the crop, all the experimental plots were laid in a 7-acre block, in which four plots of 1 acre each were marked out, two plots on either corners, and the middle 3-acre area forming a buffer. In the two plots on one corner, parasites were released in one plot, and parasite release together with earthing up was done in the other plot. In the two plots of the other corner, only earthing up was done in one plot and the other formed control plot without any treatment.

Trichogramma parasites were sent from the Parasite Laboratory, Mandya, and were released at weekly intervals for 12 weeks at the rate of nearly 24,000 parasites per plot per week.

Light earthing up could easily be done with a 13½" *kunte*[2] in a spacing of 18" between the rows. This was found the most suitable out of four *kuntes* of different lengths tested simultaneously with bamboo strips on the blades to find out the size of the *kunte* suitable for light earthing up. The operation was repeated after 1 month. The object of light earthing up was to cover the bases of the plants to prevent the newly hatched caterpillars from boring at the base. The apprehension that earthing up adversely affects tillering is found to be incorrect; on the other hand, it promotes vigour and profuse tillering, besides preventing weeds in the field.

To study the effect of the treatments, dead-heart counts were made by noting the number of healthy and affected shoots in 20 subplots, each measuring 6′ × 6′, selected at random in each plot at an interval of 1 month (3 weeks in the first year) each for 3 months. The incidence of the different dead-heart-borers during the growth period of the crop was studied by random collections of a large number of dead-hearts at an interval of 1 month (3 weeks in the first year) each for 3 months and their examination for each species of borer larvæ. *Chilo* egg-masses—both parasitised and healthy—were collected in each plot and also in the neighbouring bulk area at monthly intervals (at an interval of 3 weeks each in the first year) for 3 months to study the colonisation of *Trichogramma* after releases as well as its natural incidence in the area in general.

III. Incidence of the Different *Jola* Dead-heart-borers

Three species of insects caused dead-hearts in *jola, viz., Chilo zonellus* Swinhoe (Pyralidæ, Lepidoptera), *Sesamia*

[2] Blade hoe.

inferens Walker (Noctuidæ, LEPIDOPTERA) and *Atherigona indica* Malloch (Anthomyiidæ, DIPTERA). Their incidence was noted from an examination of a large number of dead-hearts collected at random in the plots at definite intervals representing the different stages of growth of the crop.

TABLE I

Percentage incidence of the different jola *dead-heart-borers during the growth period of the crop in* 1954-57

Age of the crop	*Chilo zonellus*			*Atherigona indica*			*Sesamia inferens*		
	1954–55	1955–56	1956–57	1954–55	1955–56	1956–57	1954–55	1955–56	1956–57
1 month ..	5·4	15·0	21·6	94·6	84·9	63·1	Nil	Nil	15·3
1¾ months ..	15·7	..	..	50·4	..	..	33·9	..	..
2 months ..	..	18·1	16·0	..	49·5	53·0	..	32·3	31·0
2½ months ..	53·8	..	..	23·0	..	..	23·0	..	..
3 months ..	..	62·7	29·5	..	17·0	2·3	..	20·3	68·1
3¼ months ..	38·4	..	..	Nil	..	..	61·5	..	..
4 months ..	25·8	8·8	28·2	Nil	Nil	Nil	74·1	90·1	71·1

The seasonal incidence of the three *jola* dead-heart-borers is plotted on the graph (Fig. 1). The curve for the incidence of *Chilo zonellus* is a parabola. *Chilo* occurs in small numbers in the first month, and gradually rising in the second month, it reaches its maximum in the third month, when it is also the most predominant species; afterwards its numbers fall but continue to be fairly abundant till harvest. *Atherigona indica* is most predominant in the first month of the crop and continues to be abundant at the second month, but it falls in numbers considerably through the third month and is absent in the subsequent period. The graph of its incidence is, therefore, a straight descending line. *Sesamia inferens* is either absent or present in small numbers in the first month, but soon it manifests itself in increasing numbers and becomes the most dominant species in the fourth month of the crop. A curve of its incidence is a straight ascending line, with a kink in the third month.

IV. EFFECT OF *Trichogramma* RELEASES AND EARTHING UP

First, the extent of infestation on the basis of the number of dead-hearts, and *secondly,* the percentage of parasitisation of *Chilo* egg-masses both before and after the treatments formed

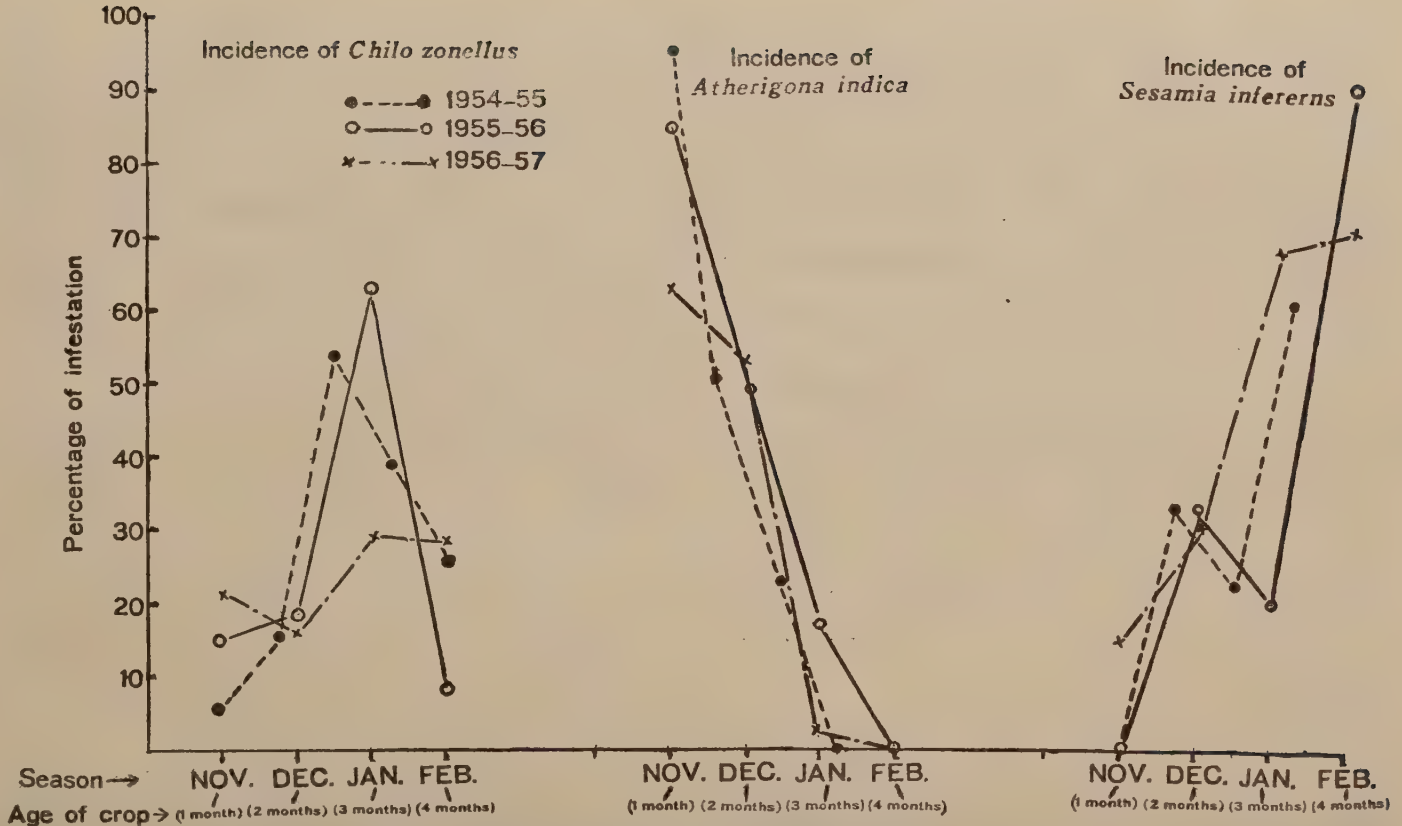

FIG. 1. incidence of the *jola* dead-heart borers.

TABLE II

Percentage of attack by the jola *dead-heart-borers and percentage of infestation by* Chilo zonellus *before and after* Trichogramma *releases and light earthing up treatments during* 1954-57

Age of Crop	Percentage of attack by borers/Percentage of attack by *Chilo*											
	Parasite release plot			Par. Rel.+Earthing-up			Earthing-up plot			Control		
	1954–55	1955–56	1956–57	1954–55	1955–56	1956–57	1954–55	1955–56	1956–57	1954–55	1955–56	1956–57
						(i) Before Treatment						
1 month ..	21·8 / 1·17	1·65 / 0·24	39·6 / 10·4	21·8 / 1·17	3·68 / 0·45	31·1 / 7·05	15·8 / 0·85	21·1 / 3·16	32·7 / 9·15	18·5 / 0·99	13·2 / 1·98	22·6 / 4·04
						(ii) After Treatment						
1¾ months ..	20·8 / 3·26	..	..	11·8 / 1·85	..	..	12·0 / 1·88	..	..	16·1 / 2·57	..	..
2 months ..	..	3·5 / 0·63	18·5 / 3·33	..	5·6 / 1·01	16·1 / 2·25	..	3·7 / 0·66	16·0 / 2·56	..	5·3 / 0·95	21·1 / 3·37
2½ months ..	14·5 / 7·80	..	..	18·5 / 9·95	..	..	10·0 / 5·38	..	..	21·6 / 11·6	..	..
3 months ..	.. / 17·1	5·53 / 3·46	8·2 / 2·41	..	5·09 / 3·19	8·6 / 2·53	..	5·51 / 3·45	10·0 / 2·95	..	6·02 / 3·77	12·8 / 3·77
3¼ months ..	4·41	..	..	21·1 / 5·44	..	..	11·0 / 2·83	..	..	20·0 / 5·16	..	..
4 months ..	23·9 / 6·16	41·6 / 3·6	20·3 / 6·09	42·9 / 11·6	44·4 / 3·9	18·3 / 5·16	32·0 / 8·25	61·3 / 5·3	21·2 / 6·99	25·4 / 6·55	64·2 / 5·6	23·1 / 4·18

the two important criteria for judging the effect of *Trichogramma* releases and light earthing up.

(*a*) *Incidence of the Borers Before and After Treatments.*—The percentage of attack by *jola* dead-heart-borers and the percentage of infestation by *Chilo zonellus* before and after *Trichogramma* releases and light earthing up treatments during 1954-57 are noted in Table II.

From the data presented it will be seen that the effect of light earthing up is evident in the second month, which is continued in the third month also; but the treatment loses its effect in the fourth month when it could no longer be expected to persist in its effect, as light earthing up is intended to prevent the borers from boring in at the base in the young crop and later in older crop the borers—*Chilo* and *Sesamia*—can enter the plant at any point.

The results of the parasite release also show good trends in that there is some reduction in the borer infestation during the second and third months, when *Chilo* is most abundant; however, this position is not maintained to the end.

The results of the combined treatment of the parasite release and earthing up are in no way superior to either of the treatments given separately.

(*b*) *Natural Incidence of* Trichogramma *and Colonisation after Releases.*— *Chilo* egg-masses—both parasitised and healthy—were collected in each plot and also in the neighbouring bulk areas to study the colonisation of *Trichogramma* after releases as well as its natural incidence in the area in general.

Good parasitisation has been obtained in the parasite released plots, though the number of egg-masses collected is small owing to the difficulty to get them in the field in spite of a careful search. The total absence of egg-masses parasitised by *Trichogramma* in the other plots and in the bulk area is significant.

V. Conclusion

There are indications showing the colonisation of *Trichogramma* after releases and the beneficial effect of light earthing up as compared to the untreated control. The effect of both the treatments is evident in the second month and it continues in the third month also, when the activity of *Chilo* is at its maximum.

Table III

Parasitisation by Trichogramma evanescens minutum *of the egg-masses of* Chilo zonellus *infesting* jola *during* 1954-57

Period of collection of egg-masses	No. of egg-masses collected														
	Parasite released plot			Parasite released + Earthed-up plot			Earthed-up plot			Control plot			Bulk area		
	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)
							1954–55								
November (Before release) ..	2	..	..	..	..	..	..	..	..	..	..	..	2	..	..
December (After releases) ..	11	5	45·4	11	4	36·3	4	..	..	5	..	..	6	..	..
January ..	..	..	..	..	..	..	..	..	..	..	..	..	22	..	..
February ..	..	..	..	..	..	..	..	..	..	..	..	..	4	..	..
							1955–57								
November (Before release) ..	4	..	..	3	..	..	2	..	..	3	..	..	6	..	..
December (After releases) ..	4	..	..	4	2	50	..	..	..	..	..	..	5	..	..
January ..	9	9	100	6	6	100	..	..	..	..	..	..	..	..	..
February ..	2	1	50	..	..	..	1	..	..	2	..	..	7	..	..
							1956–57								
November (Before release) ..	6	..	..	2	..	..	2	..	..	..	..	..	12	..	..
December (After releases) ..	9	2	18·1	5	1	20·0	4	..	..	5	..	..	6	..	..
January ..	8	2	25·0	11	2	15·3	6	..	..	5	..	..	4	..	..
February ..	2	2	100	5	4	80·0	3	..	..	3	..	..	5	..	..

N.B.—(*a*) Total No. of egg-masses ; (*b*) No. of parasitised egg-masses ; (*c*) Percentage of parasitisation.

However, during the fourth month, this position is not maintained. Obviously, earthing up done during the first and second months could not continue to be effective after three months in a grown-up crop. *Trichogramma* was also not quite effective at this stage, which can perhaps be explained by the low host density (*cf.* incidence data). Very good parasitisation has been obtained in the released plots. The total absence of *Trichogramma* in the other plots and also the bulk area is very significant, although most unexpected for two reasons, *viz.*, (*i*) the absence of this universal parasite could hardly be expected; and (*ii*) particularly so, when *Trichogramma* was released in the same area against the same pest during 1949-50 by the Madras authorities.

TOWARDS GREATER FOOD PRODUCTION—I

By K. L. Bhatta* and K. Gopala Iyengar§

In Mysore, dry lands (*Bharani*) provides the greater part of the food of the people. Out of nearly 25 million acres under cultivation, an area of just under 2 million comes under irrigation. The rest of the area is dry, entirely dependent on rainfall for crop production. Practically the entire production of millets, pulses, and oilseeds is obtained from dry cultivation. The problem of more and better food is therefore a problem of upgrading the productivity of these dry lands.

The dry lands can be broadly classified into two groups—the red soils and black soils ; of which the latter are relatively more productive. The black soils are mainly in the north where the mean rainfall is less and the temperature relatively higher. Red soils situated to the west and south are predominantly cropped in the *khariff* season. In a few favoured localities, an early *khariff* (*mungar*) crop is succeeded by a *rabi* (*hingar*) crop. Deep black soils are cropped in the *rabi* season. When the monsoon is active, these soils are intermediate. Certain factors of management are common to both types of soils, and by paying proper attention to these, the productivity of the dry lands can be not only increased but also assured.

Of the several factors affecting yield, water holds the foremost place. A well distributed rainfall is highly conducive to bumper harvests, and in effect overshadows the combined benefits accruing from other measures such as manures and fertilizers, improved variety, good cultivation and adequate plant protection. It is imperative on the part of every dry farmer to make all-out efforts to obtain the maximum benefit from rain, which in its very nature is rarely distributed in a manner to promote the maximum growth of crops. It is to his advantage to see that the rain that falls on his land is retained and allowed to soak in. Torrential showers which are much too frequent result in considerable overflow. This is a double calamity, for, in addition to the loss of precious water, considerable loss of fertile top soil also takes place at the same time.

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Field bunds will, to a considerable extent, prevent these losses, by impounding the muddy water, thus allowing the sediment to settle down and the water to soak in. The size and height of these bunds are determined by the slope, the rainfall, and the permeability of the soil. Bunds ought to be closer to each other as the slope increases, the higher the rainfall, the more substantial the bunds, and the greater the permeability of the soil, the smaller the bunds. In fact, where rainfall is less and soils highly permeable, most of these bunds may be of a temporary nature, as to offer no hindrance to sowing and after cultivation. Bunds adjoining drainage ditches should be larger in size, and provided with a simple sluice arrangement. These larger bunds as well as the adjacent drains should be well grassed. Dense grass holds the bunds, prevents erosion and side cutting of the drains and also acts as a beneficial silt trap. The outfall from a higher field should not be allowed to flow into a lower one and so on, to avoid both erosion and breaching of bunds situated lower down. Bunds properly constructed and maintained will prevent erosion, assure adequate moisture for growing crops, and also help to stabilise the ground water-level.

Absorption and retention of the rainfall by the soil is, to a large extent, determined by its structure. Addition of sand and silt to heavy soil makes them more porous, and a reverse procedure favourably influences the water-holding capacity of sands and gravelly loams. Of prime importance for practical purposes in this respect is organic matter which tends to make heavy soils light and light soils moisture-retentive. Farmyard manure, compost and green manure, apart from their intrinsic value as sources of plant nutrients, are more efficacious as improvers of soil structure. To a considerable extent, they even out the hazards for crop growth due to a maldistribution of rainfall. Farmyard manure and compost should be applied in abundance to all lands dependent entirely on rainfall for crop production, green manures and green leaf to such lands where inadequate rainfall is supplemented by irrigation. An application of a 15 ton/acre of farmyard manure is supposed to assure continuous production of crops in a 3-year rotation in temperate climes. In the tropics, this quantity has to be, of necessity, more. But, this amount of farmyard manure is not always available. Compost can supplement it and a more intensive drive for the preparation of compost is very necessary. Incidentally, the growing of fuel trees will reduce the present waste of dung as fuel. Tree growth should be encouraged along bunds, ditches and

waste lands. Better housing of cattle, than at present, will also aid in conservation of manure since most urine and much of dung is not collected as the cattle are allowed to roam about too freely.

The role of legumes in crop mixtures and in rotation is widely appreciated and put into practical use. Where this practice is not in vogue, it ought to be extended. The association should be made up of relatively shallow-rooted and early-maturing millets and deeper-rooted legumes of a longer duration. The beneficial effects of legumes in mixtures and in rotation can be significantly enhanced by the application of phosphates. Phosphorus stimulates nodulation, thus promoting vigorous stands and heavier yields. Where legumes are grown as a pure crop in rotation, an application of 8 maunds per acre of superphosphate would be adequate. Where legumes are found in mixed rows, 2 md. would be sufficient for all practical purposes.

The yield of millets and other associated crops can be considerably enhanced by supplementing bulk manures with chemical fertilisers. Most of our soils are poor in nitrogen and relatively so in phosphates, and an application of both nitrogen and phosphorus will greatly stimulate yields. Two md. of ammonium sulphate together with a like quantity of superphosphate per acre, will usually be found adequate. In favoured localities where rainfall is over 25″ and is evenly distributed, this dosage may be doubled with advantage. Among oilseeds, groundnut particularly benefits from an application of superphosphate. The phenomenal increase in the cultivation of groundnut, particularly on light soils, should begin to cause disquiet. The harvest operations leave the soil surface in a very vulnerable state and an easy prey to the depredations of both wind and rain. Suitable soil conservation measures should be immediately devised to stabilise the loose soil surface.

The impression that it is hazardous to apply chemical fertilisers to dry crops is widespread. This is erroneous. It is evident that a vigorous crop is able to withstand adverse conditions better than a poor one. Fertilisers induce early vigour and stimulate a deep and widespread root system. They promote growth, and phosphates make the crop mature early and uniformly. Recently, demonstrations on the application of fertilisers to dry crops have been carried out in many parts of the State, in co-operation with the Indian Council of Agricultural

Research. These demonstrations have brought home the fact that no ill-effects have resulted but actually the harvest has exceeded all expectations. These demonstrations have also revealed that fertilised plots have fared better than unfertilised ones when the later rains have not been favourable. The grain from the fertilised plots was also well filled and plumper than that from unfertilised ones. It can now be stated with confidence, that fertilisers are quite beneficial to dry land crops.

Selected Article

THE RELATIONSHIP BETWEEN ADVISORY WORK AND RESEARCH IN AGRICULTURE

By G. J. Vervelde*

1. Research and Farmers' Problems

Hardly a government exists that is not concerned in agricultural progress. Progress depends on a number of physical and economic conditions, but also require theoretical knowledge inventiveness, practical experience and knowledge of the actual situation. These personal factors are required in different proportions, depending on the type of improvement to be made. Theoretical knowledge and inventiveness are qualities one may expect in research workers. On the other hand, farmers are well known for their practical experience and knowledge of the situation on their farms.

There are two types of problems in practical agriculture.

(*a*) *Specific Problems.* These continue to arise in great numbers; they can be attributed to very definite causes, such as many diseases in crops and animals, or can be described either as well-defined imperfections, such as defects in the quality of agricultural produce, trouble with machinery and equipment, or as concrete questions, *e.g.*, the right amount of nitrogen for a certain crop.

(*b*) *General problems,* such as labour shortage, unsatisfactory results of the farm as a whole or of certain details of the farming enterprise, new tasks imposed on the farmer by political or economic necessities.

The problems of the second kind may, upon investigation, appear to belong to the first category, but this is not always so. In this case it is necessary to consider the structure of the farm as a whole, or the details involved.

In many of the simpler cases, all that is required is a certain amount of brainwork and ingenuity on the part of the

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farmer. There remain, however, quite a number of other cases. For these there are two possibilities:

(*a*) previous research may have proved some kind of solution which has only to be brought to light and adapted, and

(*b*) the problem requires new, original research.

In both cases even educated farmers cannot be expected to possess sufficient knowledge of the store of information already available, or to be able to formulate their problems in terms of the scientific research required. For these and other purposes, in nearly all countries, advisory services are available in which University-trained agriculturists and horticulturists hold the highest positions. They have been given the position of intermediary between practice and research. This does not mean, however, that the farmer and the research bodies are the only two parties that really matter, the advisory service being a more or less passive link between them. The advisory service certainly has a creative task, and in order to accomplish it they should be supported and accepted by both research workers and farmers.

In order to be of any help to farmers and gardeners, the advisory service has to combine all the qualities mentioned in the beginning of this paragraph: theoretical knowledge, inventiveness, practical experience and insight into the actual situation. Each of these qualities can be developed by a different type of research. Theoretical knowledge is increased by factorial research, inventiveness is indispensable in developmental research, practical experience is gained by empirical research, and the actual situation can be studied by means of operational research. These four types of research, *plus* a fifth less well-defined type, preliminary research, cover the whole field of agricultural research.

2. The Different Types of Research

(*a*) *Preliminary or Exploratory Research.* The first steps taken to tackle a problem. It usually consists in finding out what is roughly known about a problem, what factors may be involved, and what practical possibilities apparently exist for eradicating the trouble.

(*b*) *Factorial Research.* An analytical study of the part played by individual factors in some phenomenon or process, *i.e.*, a study of relationships. The effect of any single factor

may be studied, but it may also be necessary to study the factors in combination in order to find the interactions. The factors may correspond to some practical treatment (nitrogen dressing, time of sowing), in which case the results of factorial research have direct applicability. In most cases the factors are defined in such a way as to give the best possible description and explanation of the process or phenomenon, such as the botanical analysis of grassland, the mineral composition of crops, the percentage of pore space in soils. The results then give no direct information on practical measures to be taken.

(*c*) *Developmental research* commences when it is required to determine the best methods of handling factors of which the effects have been established by factorial research. Thus, it has been known for more than 20 years that pH is a determining factor in conserving vegetable material, yet investigations into the different methods of obtaining low pH still continue. Successful developmental research indicates what practical measures are required.

(*d*) *Empirical Research.* This type of research, quite common in agriculture, does not start from knowledge of the factors involved, but from what seems to be practical possibilities (trial and error method). Thus, if some quality defect is to be eliminated, it is possible to test whether the desired effect can be obtained using a different type of manure or fertilizer.

(*e*) Surveys, questionnaires, variety tests, routine testing of soils and seeds can all be considered as a kind of *operational research,* that is, an assembling of data on the actual situation as a basis for action.

3. The Task of the Advisory Service in Agricultural Research

As most farmers' problems are recognized by the advisory officer or referred to him in the first place, he is the first to analyse the problem and consider remedies. In quite a number of cases he will be able to suggest measures to be taken. In other cases, a few simple experiments by the advisory service will provide the answer. They will be directed to practical measures rather than to the elucidation of the underlying factors, and thus they come under either empirical research or the development research or the development research group.

In other cases the problem may be more complex and require special research. Even then, the advisory service may be

in the best position to carry out this research, especially if the problem is not of a national character and the investigation involves a number of field experiments.

But, even if the problem has to be taken over by a research institute, the aid of the advisory officer who carried out the preliminary research should be enlisted in planning the project and the ensuing activities, if only in a consultative position. In the Netherlands there have been many instances of substantial improvements in farming practices originating from ideas put forward by advisory officers.

Likewise, in the case of research that was not begun in order to solve urgent problems, but is undertaken for its own sake, the advisory officer may play a very useful part by giving his opinion on the practicability of possible treatments or measures investigated.

The tasks of the advisory service with respect to research does not end here. There are research activities, such as testing crop varieties, that are best undertaken by research stations with a specialized staff, but require experiments in many different places scattered over the country. Other investigations by research institutes require work on commercial farms, *e.g.*, when farm management, labour problems or economic questions are involved. In these cases, co-operation between the research institute and the advisory service, the latter doing the local work, will not only ensure that investigations are carried out under the most suitable local conditions, but also an immediate application of the results by the advisory staff taking part in the work. A number of projects of this type have been organized in this way in the Netherlands. They are called "inter-provincial series". Such series usually come under the headings of developmental and empirical research, but in some cases they may be of the factorial type.

There are other advantages in organizing research in this way. The experiments can also be used for demonstration purposes. The staff detailed to perform and supervise the experiments gain experience in new methods tested in the experiments. The research task keeps the advisory staff abreast of research developments and also enables them to adopt a critical attitude towards anything advocated as an improvement.

The various research activities of the advisory service have their own special needs. The advisory officer should have a

small number of assistants and the necessary equipment for carrying out research work. In some cases the advisory officer may be the Director of a small regional research station. An experimental farm will be very useful, but it is also possible to arrange with some farmer for a number of experiments to be centred on his farm.

It is useful to arrange for a committee, in which the central institutes are represented, to examine proposals for new research made by various districts of the advisory service. This prevents trivial problems from taking up too much time and effort. Moreover, if some problem is found to have arisen in several districts at the same time, the problem may be earmarked as the responsibility of one specific institute. It is useful to collect in an annual index research projects carried out in the various districts. No conclusions should be drawn from a small number of local experiments if similar experiments have been carried out elsewhere. It is probably one of the few defects of the system of decentralized research in the advisory districts that the experiments sometimes lead to rash conclusions based on the evidence of too little experimental data. Registration, classification and publication of all local and central research projects are means of informing all parties concerned of research elsewhere that is related to their own work.

There is one final research task for the advisory staff. They have to ensure that the results of agricultural research are applied under conditions for which the results are valid and on farms where the application is economical. In simple cases it will be possible to instruct the farmer how to decide for himself what action should be taken. In other cases, the farmer may not have means of evaluating the situation and the local advisory officer may then be in the best position to perform this type of "operational" research, probably by means of a survey, questionnaire or the like. Under this heading come research programmes such as : the possibility of tile drainage, the frequency of drought, damage in connection with supplementary irrigation, and the incidence of mineral deficiencies in crops and animals.

4. The Task of the Research Institutes with Respect to the Advisory Service

It has already been mentioned that the institutes for agricultural research will be well advised to secure the co-operation of advisory officers in planning or performing research

activities intended for immediate practical application. Most of the results, however, have to be elaborated and examined in a highly specialized manner and the conclusions are formulated in technical professional terms which are not readily understood by less specialized workers. The same applies to basic research. Thus, there is a very clear task for the research bodies in making the results available to the staff of the advisory service. If they value a speedy application of scientific knowledge—and who does not ?—it should be presented in such a form that it can be used by a sufficient number of persons whose task it is to promote progress in practice. They should not have to obtain the information by struggling through a bewildering mass of scientific papers. The research authorities, like good salesmen, should consider it their duty to present the information in a palatable and readily comprehensible form. Several methods are possible : the results can be recorded in papers or bulletins, courses can be arranged or demonstrations can be given. In all cases, it will be advisable to have a special officer in charge of this dissemination work. Whether they should be on the staff of the research institute or belong to the advisory service personnel is not very material. The best plan would probably be to employ these officials in the advisory service in countries where the farming practices lag far behind available scientific knowledge. As soon as the gap has been closed, it may be sound policy to engage them in the research institutes.

It should be stressed that new results of basic research may be just as useful to the advisory officer as the results of applied research, inasmuch as they point out principles and relationships and thus help to classify existing knowledge and experience, and they may also explain facts which previously had to be accepted as empirical knowledge. It would seem that with the recent rapid expansion of the research institutes, the number of workers with a gift for summarizing and interpretation has not kept pace with the number of those producing figures and data. And their number, already too small, is still further reduced by the demands made on them for organizing and administrative functions.

There is another aspect of modern advisory work that requires more support by research. Present-day technical facilities enable a much greater number of production factors to be regulated and improved, even including those which not long ago were considered permanent and unchangeable. The use of

deep-digging ploughs to bring fertile subsoil to the surface, the use of irrigation techniques, the construction of storage facilities, the use of machinery or other technical equipment, are a few examples. They are all making great new demands on the advisory service staff. A high degree of adaptability and versatility are required and the advisory staff bear a great burden of responsibility, not only because of the enormous financial investments involved but because these investments are intended to serve for a great many years to come.

Again, such radical improvements change the whole outlook of the individual farming enterprise. They call for a much more synthetic view on the part of the advisory officer than do partial improvements, the results of which can be fairly easily predicted. In this, the advisory officer should undoubtedly receive much more support from the research institutes. The increasing specialisation of the research institutes works in the opposite direction, and measures should be taken to make certain research workers available to integrate new discoveries made in all the various branches of science. Plans for the improvement and sanitation of agriculture are becoming increasingly complete and all-embracing, including not only soil improvement and drainage, but also farm size, farm building, type of farming, and sometimes even the social structure as well. Research activities should so be directed as to effectively support those who have to cope with these developments.

5. Conclusions

The advisory officer should have a place in the system of agricultural research. It keeps him open-minded and obliges him to familiarise himself with new scientific developments. The part played by the advisory service in agricultural research will usually be concentrated on exploratory, developmental and operational research, but they may also have the task of carrying out simple, empirical, and even factorial research.

Special precautions should be taken to prevent this decentralization from leading to a diffusion of national research activities.

The research institutes can help the advisory officer by systematizing his empirical experience and knowledge by presenting the results of research activities in a practical and readily comprehensible form, and by paying attention to the problems of the farms as a whole.—[Courtesy: *Netherlands Journal of Agricultural Science*, Nov. 1956, **4** (4), 294-98.]

Research Notes

A SERIOUS INFESTATION OF POTATO TUBERS BY THE RED ANT, *SOLENOPSIS GEMINATA* F. IN THE FIELD

By D. Seshagiri Rao*

A small patch in the laboratory compound was planted with potato on 28-11-1956, for certain phytotoxicity trials. The plot was harvested on 14-2-1957, about 2½ months after planting. Tubers were well formed and the yield was normal. About one-third the number of tubers were badly pitted outside, a tuber of average size showing about 30-40 pits. The pits were circular or oval in outline, and about 1/10" or less across, on the outside. The damage had been caused by the red ant, *Solenopsis geminata* F., seen coming out of these tubers in large numbers when the latter were dug out. In severely attacked tubers, the tunnelling had penetrated right up to the core (Fig. 1). When such badly attacked tubers were stored for about a month (after driving out all the ants) they had shrunk in the heavily tunnelled portions, with the skin crumpled and dry, due to dehydration. In extreme cases, the entire potato had become unshapely, quite dry, discoloured, and spongy inside with the dried, furrowed and crumpled skin hanging on precariously and developing wide gashes here and there (Fig. 2). One or two of the badly affected tubers had become pulpy inside, with a discoloured, malodorous fluid and a heavy incidence of saprophytic flies all over (Fig. 3). The bulk of the affected potatoes, however, retained their shape and were firm to touch, although they were unmarketable on account of the pitting outside.

The soil of the area is light with a slight admixture of sand. The plot is under vegetable crops all through the year and is frequently watered by hand. Before harvesting, this potato patch had not been watered for some days, and the dry soil was probably very helpful to the ants to find their way, in numbers, to the tubers, below.

It is ascertained that it is not an uncommon phenomenon to find red ants boring into potato tubers in the field when the soil is rather dry, but the writer has not seen references to it in literature.

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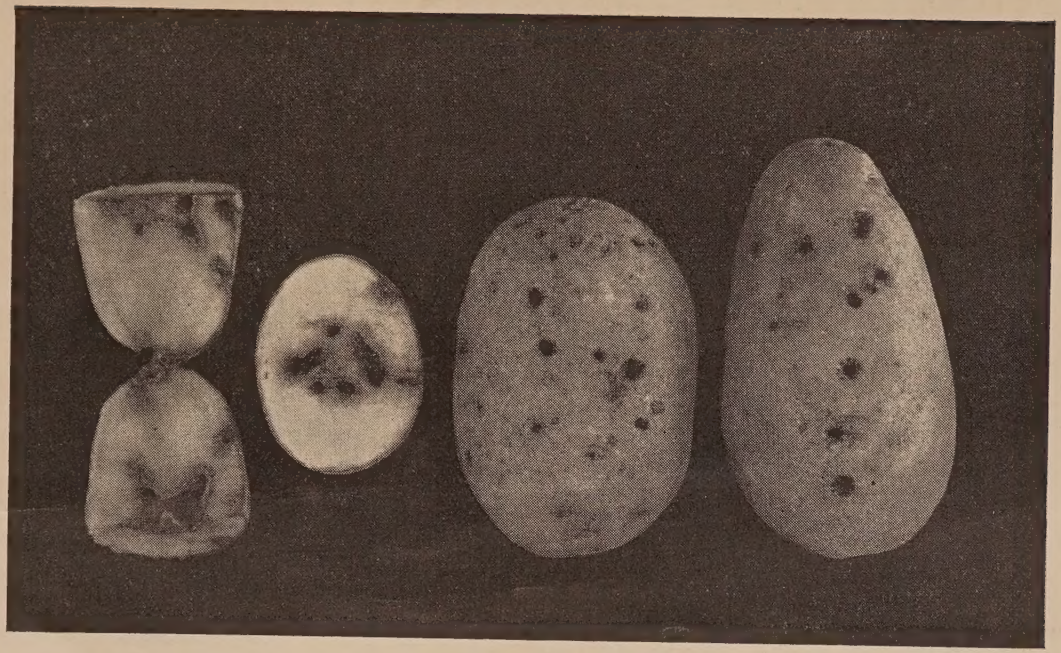

FIG. 1

FIG. 2

FIG. 3

RAICHUR BARBADENSE : A DESIRABLE PERENNIAL COTTON

By B. Srinivasa Rao*

Due to division of India, large areas of Punjab and Sind, growing medium and long staple cottons have gone to Pakistan resulting in the reduction of output in India. The approximate annual shortages with regard to these cottons at present as per estimate, by N. R. Bhatt and Kelkar in 1951-52, is as below :

Medium staple	..	.. 18,00,000 bales
Long staple	..	.. 15,00,000 bales

In order to increase the supply of cotton, many extension measures are afoot in India. Growing of quality perennial cottons in backyards, house compounds, waste lands, hedges, bunds and along watercourses are advocated as measure for supplementing the short supply of raw cotton, both for mill and handspinning.

The perennial cotton work on the Raichur Farm was initiated by the cotton section in the year 1950-51. A number of perennial cotton types was obtained and tried, but the one existing in the garden area is an interesting discovery. It has been found to be an Egyptian type with a staple length of 1·27" and is capable of spinning 60 warp counts. The plant is now known as *Raichur Barbadense*, the seeds of which are in great demand from all over India. This has been multiplied on the Farm and has been found to grow very vigorously under Raichur conditions. It is relatively free from pests and diseases, and if utilised properly, will go a long way in augmenting the supplies of the extra long staple cottons that are in great demand. Attempts are also under way to utilise this plant in cross-combination with Laxmi and other annual forms to breed an extra long staple cotton for the Tungabhadra Project.

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